

The Relationship of Bacteria to the Common Cold

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This subject is a complex and surprisingly vague one. Much of the available data are very old, and in the forthcoming discussion I shall lean heavily on work done many years ago by ourselves and others. To begin with, I am going to pose four questions, and the discussion will take the form of an attempt to answer them. The four questions are as follows:

1. What bacteria are important in common upper respiratory infection?
2. Can and do bacteria initiate colds?
3. If not, what role do they play in colds?
4. What relationship do they have to epidemiology?

Let us now attempt to frame answers to these in order:

1. β hemolytic streptococci, *H. influenzae* and pneumococci need no defense as respiratory pathogens, and I am going to assume that they are pathogenic. I assume that Friedländer's bacillus is also a pathogen, but it is sufficiently rare so that I am going to omit it from the discussion. Abundant studies of respiratory bacteriology for many years have indicated that various *Neisseria*, non-hemolytic streptococci, diphtheroids, etc. constitute the normal "basal flora," and are not significant in disease. I am going to add staphylococci to this basal flora, for although they may occasionally act as secondary invaders, I believe that this role has been considerably over-emphasized in the past, particularly by otologists. The discussion, therefore, will revolve around hemolytic streptococcus, *H. influenzae*, and the pneumococcus.

2. Can and do bacteria initiate colds? If we consider our three pathogenic organisms one by one, the idea of exudative pharyngitis due to hemolytic streptococcus immediately comes to mind. "Strep. throat," "follicular tonsillitis"—certainly this is a clinical entity of which the hemolytic streptococcus is commonly believed to be the

cause. But can a virus component in the etiology be dismissed? It seems to me that it can be. For one thing, some of the most florid outbreaks of this condition have been shown to be milk- or food-borne. Moreover, the spread of hemolytic streptococci in hospitals, particularly from nasal carriers, was carefully studied in the last war, and there was no evidence of a virus component. It would appear, therefore, that the hemolytic streptococcus may be a primary incitant of common respiratory disease—but it causes "strep. throat," and this is *not* the common cold.

In regard to *H. influenzae* and the pneumococcus, no strictly analogous situation exists. To be sure, there have been rare outbreaks of disease such as the so-called "Woodside throat" in Australia at the beginning of the last war, which were believed due to a primary *H. influenzae* pharyngitis of very severe character. Cooke et al.¹ adduced some evidence against a virus component here, but it was not conclusive. On the other hand, our own studies² as well as those of others, would indicate that when nose and throat cultures are taken in the same individuals regularly, both *H. influenzae* and pneumococci may appear and disappear in a manner apparently unrelated to attacks of the common cold. Even in the well-known studies of semi-isolated communities by Burky and Smillie,³ where these organisms were prominent during epidemics respectively in Labrador and Alabama, they could not be recovered in every case, and appeared late in many of the cases. The classical study of the completely isolated community (Spitzbergen) was reported by Paul and Freese in 1933.⁴ It will be remembered that from December 1 until the end of May, the period when this little community was ice-bound, only 19 colds occurred among 500 inhabitants. Moreover, during the last

3 months of the period there were only four, three being in the same individual. Yet *H. influenzae* and pneumococci (as well as hemolytic streptococci) were recovered from the population throughout these winter months—and with about the same frequency as they were found when colds suddenly became rampant following the arrival of the first boat in the Spring. This whole experience powerfully suggested that bacteria were not the inciting agents of the common cold, at least of the communicable type, and the presence of a virus was naturally inferred. In reviewing all the evidence over the years, one is led to the conclusion that, while there is no proof that bacteria cannot cause colds, ordinarily they do not.

3. What role do pathogenic bacteria play in the common cold? It is very tempting to say that they act as “secondary invaders,” and let the matter rest there. Yet when one studies the available evidence, it is extraordinary how difficult it is to define their function as secondary invaders. Dingle and his co-workers,⁵ for instance, after exhaustive studies of acute respiratory disease in the Army, came to certain beliefs in regard to the streptococcus. For one thing, they concluded that hemolytic streptococcus caused only about a quarter of the cases clinically designated as “exudative pharyngitis,” and where it was not etiologically significant the mere presence of streptococci did not affect the course of the disease. On the other hand, Coburn⁶ reported that mass sulfadiazine prophylaxis in the Navy resulted in a marked reduction in hospital admission rate. He stated that the morbidity rate for virus diseases remained unaffected, but the data suggest that the principal result of prophylaxis was the virtual elimination of frank streptococcus disease in a highly susceptible population.

The pneumococcus presents a somewhat different problem. Experiences in our own infants and chimpanzees^{7,8} both of which are highly susceptible to severe colds, indicated that the presence of this organism appeared related to the severity of the common cold. The same finding was made by Burky and Smillie⁹ amongst Alabama

school children. Another method of approaching the problem is by the use of specific chemotherapy or antibiotics. Siegel,⁹ working at Letchworth Village with retarded children as subjects, concluded that early sulfadiazine treatment of common respiratory disease reduced the duration of fever, general severity, and complications in a controlled series. Lapin¹⁰ gave oral penicillin to 160 children for a year and found the days of fever reduced from 24 to 5, and the number of febrile respiratory infections from 5.6 to 1.8 per child as compared with the previous year. Minor coryza, however, continued. On the other hand, Rusk and Van Ravenswaay¹¹ working with military personnel, a less highly susceptible population, found that sulfadiazine treatment of common respiratory disease did not affect the duration of fever or the length of hospital stay.

The situation in regard to *H. influenzae* would appear to be analogous to that of the pneumococcus. Burky and Smillie⁹ made very similar observations of its behavior in Labrador to that of the pneumococcus in Alabama. We have noted it in severe colds both in the infant and in the chimpanzee. If we attempt to sum up, then it would appear that the role of the streptococcus is equivocal in instances where it is not the primary incitant of disease, and that pneumococcus and *H. influenzae* can enhance the clinical severity of colds in highly susceptible individuals, and produce such complications as sinusitis, otitis, and pneumonia. On the other hand, most of the effects of the common cold in adults are probably due to the virus and not to bacteria.

4. Are bacteria related to epidemiology? Again, the evidence on this point is rather scanty, and tends to be indirect. We observed¹² in the chimpanzee a shift from the R to the S form of *H. influenzae* in throat cultures taken during spontaneous and experimental colds. In free intervals only the R form could be recovered, but with infection a reversion took place to the same S type as that obtained during the previous cold. This highly suggestive example of interaction of virus and bacterium has never

been duplicated in man. In another very susceptible type, however,—the human infant—we have noted some apparent relationship of the two types of agents. In a group studied throughout one winter¹³ it was believed that the first Autumn wave of colds, presumably of virus origin, resulted in a widespread dissemination of pneumococci. Then, later on, when the carrier rate was 80 per cent or thereabouts, an outbreak of colds took place which showed not only considerably increased clinical severity, but also a higher incidence. It is also worthy of note that in Burky and Smillie's experience⁹ the outbreak of colds in Alabama and Labrador—again in very susceptible populations — associated with pneumococcus and *H. influenzae*, also showed this clinical severity and high incidence.

With such evidence as this before us, it is permissible to frame a tentative answer to the last question. One action of the virus may be to increase the dissemination of pathogenic bacteria, and perhaps in certain instances to alter their essential virulence. With the ground thus prepared, the same or another viral agent, acting in conjunction with bacterial agents, may be more highly communicable and more infective.

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